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### SYMBOLS

$d_1$	Actual small end diameter inside bark - inches
$d_2$	Actual large end diameter outside bark - inches
$d_1'$	Small end scaling diameter inside bark - inches
DI	Density index - pounds per cubic foot
L	Actual length - feet
$L^{"}$	Scaling length - feet $(L = L^{\dagger} + \text{trim allowance})$
n	Number of truckloads in the sample for the density index
$V_B$	Scribner log volume - board feet
$V_C$	Cubic log volume inside bark - cubic feet
$\hat{v}_{C}$	Estimated cubic volume outside bark - cubic feet
W	Actual log weight - pounds
$\hat{\mathcal{W}}$	Estimated log weight - pounds

### ABSTRACT

This paper presents a practical method of estimating the weights of logs before they are yarded. Knowledge of log weights is required to achieve optimum loading of modern yarding equipment. Truckloads of logs are weighed and measured to obtain a local density index (pounds per cubic foot) for a species of logs. The density index is then used to estimate the weights of remaining logs before they are yarded. Estimates are made directly from graphs, tables, or a slide rule.

KEYWORDS: Logs, weights, logging.

### 1.0 INTRODUCTION

The forest industry has long recognized the need for a practical method of estimating the weight of logs before they are yarded. This need has accelerated as aerial logging systems having critical weight limitations find wider application. Analytical techniques which provide payload capabilities for these yarding systems are now available. Log weight estimates are needed for optimum utilization without overloads.

This paper presents a method of estimating log weights by use of a factor called a density index. Before log weights are estimated, the local density index for a species of logs is found by measuring and weighing truckloads of these logs. The density index, found in this manner, is used to estimate the remaining logs of the same species before they are yarded. Graphs and tables for estimating log weights are given as well as the mathematics for a slide rule.

This practical method of estimating log weights should be of interest to all concerned with the operation of weight-sensitive timber harvesting equipment.

### 2.0 BACKGROUND

A cooperative study / with the University of Washington's College of Forestry was performed to obtain some insight into the variations in log density. This study analyzed logs of several species from locations in Alaska and Washington. Analysis showed that the ratio of weight to cubic log volume has a much smaller variation than the ratio of weight to board-foot volume, and the study recommended that further efforts be directed toward a method of weight estimation based on cubic volume. Appendix I discusses the board-foot to cubic-foot ratio as a function of log size.

### 3.0 ANALYTICAL APPROACH

In order to devise a practical method of estimating log weights, several assumptions were made. These are listed below:

- 1. Reasonably accurate cubic volumes of logs can be obtained from the scaling length, the large end diameter outside bark, and an assumed taper.
- 2. A sample of log cubic volumes and weights can provide a measure of the green density (density index) which can then be used to estimate log weights.
- 3. The green density of logs is reasonably constant for a given species and location.
- 4. Gradual changes in the green density due to location and seasonal variations can be determined by a moving average of the density index.

½ K. J. Turnbull, L. V. Pienaar, and I. E. Bella. Report on a study of log weight estimation. (Unpublished paper on file at Pac. Northwest Forest & Range Exp. Stn., Seattle, Wash.)

5. Volumetric errors, due to differences between actual scaling lengths and between actual and assumed taper, can be considered compensating in that the error is contained in both the sample of logs used to determine the average density value and in logs for which an estimate of weight is desired.

These assumptions ignore minor variations which are known to occur so as to allow formulation of a practical method of estimating log weights. Diameters are measured outside the bark to account for volume of the bark and to include variations in bark thickness.

There are variations in taper from tree to tree and from log to log in the same tree which can cause errors in cubic volume estimates. A method of estimating cubic volumes from the length and the sum of the end diameters has been suggested. While this method may yield more accurate cubic volume estimates, it cannot be directly applied to the critical problem of determining the length to buck a log for a given weight. The bucker generally knows the large end diameter since logs are cut from the butt end to maximize value. With a system based on the sum of the diameters, the bucker is left with two unknowns at this point: the length and the small end diameter. This method, based on large end diameter with an assumed taper, provides the bucker with a direct means of determining the length to be cut for a given log weight.

Cubic volume approximations and variations inherent in green density cause differences between actual and estimated log weights. For a yarding system that has little or no tolerance for overloads, estimates of log weights must be below specified capacity to reduce the probability of overloads. For example, assume the difference between estimated and actual weights for individual logs has a standard deviation of 12 percent of the actual weight. A reduction in capacity of 10 percent for estimating the weight of single log loads would result in the probability that about one load in five is over capacity. A reduction of 20 percent would result in less than one load in 20 being over capacity.

The mathematics of this method follow from the assumptions listed. From a sample of logs, a density index is found by taking the ratio of log weight to cubic volume. If truckloads of logs are used, the procedure given in Section 4.1 consists of finding a density index for each load,

$$DI = \frac{\Sigma W}{\Sigma \hat{V}_C},$$

(see the list of symbols, inside front cover, for the meaning of these and other symbols) in the sample and then obtaining an average of the density indexes,

$$DI = \frac{DI_1 + DI_2 + DI_3 + \dots + DI_n}{n}.$$

The cubic volumes for the sampled logs can be obtained from tables 1 and 2 (Appendix II). These cubic volumes are based on the formula,

$$V_C = \frac{\pi}{576} \left( d_2 - \frac{L}{16} \right)^2 L$$

which assumes a taper of l inch per 8 feet of length. In the calculation of the values listed in the table, a trim allowance of l inch per 4 feet of length was added to the scaling lengths.

Applying the density index in order to estimate log weights can be considered the reverse of obtaining the density index. Namely, log measurements are used to obtain the cubic volume which is then multiplied by the density index to estimate the log weight. That is,

$$\hat{W} = (DI) \hat{V}_C .$$

In practice, the user need not be concerned with cubic volumes. Tables, graphs, and the mathematics of a slide rule have been provided so that a weight estimate can be obtained directly from the density index, the large end diameter, and the scaling length. Both the curves and the tables for log weights in Appendix II are based on the same equation as used previously for the cubic volumes.

An alternate method of estimating log weights can be provided by a slide rule. This requires that the previous expression be transformed into a form similar to

$$\log \left(\frac{\hat{W} \cdot 576}{\pi}\right) = \log (DI) + \log (d_2 - \frac{L}{16})^2 + \log (L).$$

However, the above equation is not satisfactory for a slide rule because the variable (L) appears in the logarithm of two terms. The ( $d_2$  - L/16) term can be approximated by ( $d_2$  - 2) for lengths up to 40 feet. This corresponds to a length of 32 feet. If logs weighing 10,000 pounds with a density index of 50 are considered, this approximation results in estimates that are about 4 percent low for a length of 10 feet and about 4 percent high for a length of 40 feet. These percentages will be larger for lighter logs and smaller for heavier logs. For lengths beyond 40 feet, the error introduced by the approximation becomes large. To avoid excessive errors, lengths for the slide rule beyond 40 feet can be obtained from the graph for a density index of 50 and a log weight of 10,000 pounds. Figure 1 shows a slide rule for estimating log weights.

### 4.0 SUGGESTED PROCEDURE

The following is a suggested procedure to obtain log weight estimates. The procedure consists of determining a density index for each species and location by sampling logs. Once the density index has been determined, the weight of logs can be estimated.

### 4.1 Sampling for the Density Index

The density index is found from an initial sample of log weights and dimensions. Truckloads of logs are convenient units to obtain these data. The

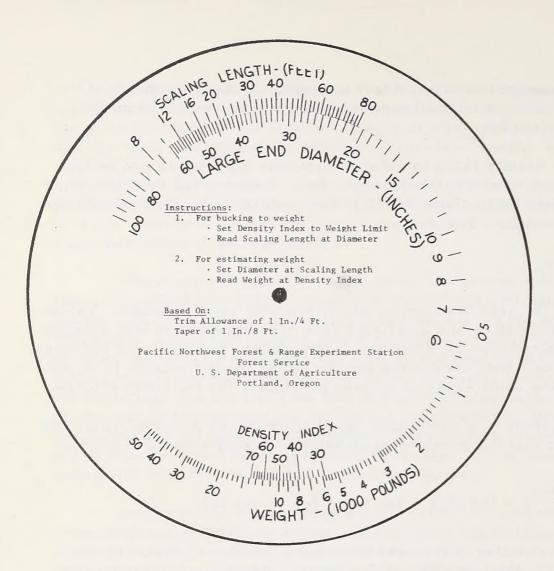


Figure 1.—Slide rule for estimating log weights.

density index can be obtained from other sources such as individual log weights and measurements or knowledge from previous nearby logging operations. Four or five truckloads or their equivalent in individual logs should generally be sufficient for a reasonably accurate density index.

To compute a density index for a truckload of logs, the net log weight and cubic volumes must be determined. Scaled cubic volumes are obtained from the large end diameter outside bark and the scaling length by referring to tables 1 and 2 of Appendix II. A worksheet is given in figure 26 of appendix II to facilitate the determination of density index of a truckload of logs. An average of the density indexes of several truckloads provides the density index for estimating log weights.

A moving average can incorporate density changes due to time, dependent influences such as seasonal variations, and gradual changes in location. A moving average is constructed by periodically obtaining a new sample for incorporation in the average density index and eliminating the oldest sample. An example of a four-load moving average of density index is shown in figure 2. A worksheet (fig. 27) is provided in Appendix II.

### 4.2 Estimating Log Weights

Once a density index has been established for a particular location and species, the weights of logs can be estimated from the graphs or tables in

Figure 2.—Example of moving average of density index.

Four-load moving average

Logging site: Paddle Creek Species: Douglas-fir

Sample number	Date of sample	Sample density index	Moving total of density index <u>l</u> /	Current moving average <u>2</u> /
1	Jan. 2	45.2		
2	Jan. 2	51.2		
3	Jan. 2	40.1		
4	Jan. 3	49.7	186.2	46.6
5	Mar. 2	42.0	183.0	45.8
6	May 3	43.5	175.3	43.8
7	July 1	41.7	176.9	44.2
8	Sept. 2	52.8	180.0	45.0
9	Nov. 2	44.5	182.5	45.6

 $<sup>\</sup>frac{1}{2}$  Add newest sample and delete oldest sample which was included in previous total.

Appendix II, or from a slide rule. Each of the graphs and tables in Appendix II is for a specific density index. A range of density indexes from 30 to 70 pounds per cubic foot is included. The nearest density index established by sampling is used for estimating log weights.

Two different problems are encountered when attempting to determine capacity loads for yarding equipment. In large diameter timber, single logs may make up the majority of loads and each log must be sized to approach the weight limit of the equipment. In smaller diameter timber, an estimate of the weight of each log is necessary to combine a number of logs into a capacity load. The graphs are arranged for the solution of either problem. When the size of a single log must be found to approach a capacity limit, the graph nearest the required density index is entered along the bottom with the large end diameter. A line is followed up to the appropriate log weight and then over to the log scaling length. When estimates of log weights are required, the graph is entered along the bottom with the large end diameter, and the line is followed upward until the proper length is reached, and the weight is read. Large end diameters should be measured outside the bark and lengths should be those defined by local custom or contract. The tables are used in a similar manner. For a single log load, the large end diameter is located in the table. The indicated

 $<sup>\</sup>frac{2}{}$  Divide moving total by number of samples in moving average.

row is followed until the weight at or just below the limit is found. Bucking length is then obtained from the top of the table. For a multilog load, the weight estimate of each log is found directly from the large end diameter and scaling length.

Butt logs must be treated somewhat differently from other logs because of the concave exterior surface due to the root swell. Probably the best way to handle these logs is to make an estimate of the large end diameter outside the bark as though the taper of the log continued through to the end, disregarding the swell, as shown in figure 3.

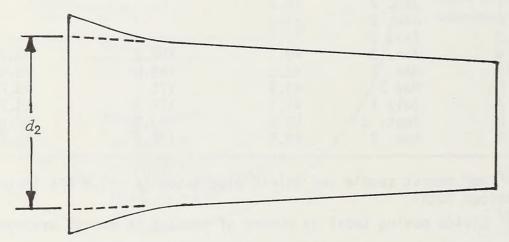
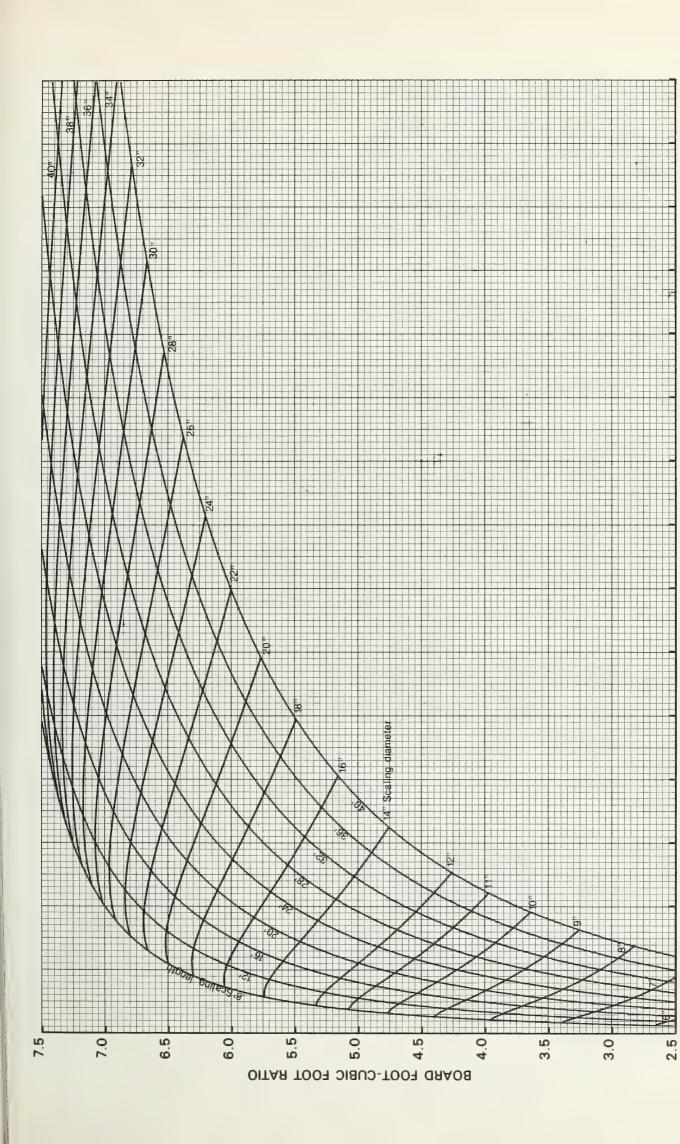


Figure 3.—Estimating large end diameter  $(d_2)$  on butt log.

# APPENDIX I THE BOARD-FOOT TO CUBIC-FOOT RATIO

Log weight estimates are commonly obtained by multiplying the boardfoot scale of a log by a constant. The particular constant usually depends on
the species of the log and the experience of the estimator. Use of the boardfoot scale as a basis for weight estimates is due primarily to the logger's
familiarity with that system of measurement. Unfortunately, the board-foot
scale is only an estimate of the lumber yield of a log rather than a measure of
its wood content.

Figure 4 shows the relationships between the board-foot to cubic-foot ratio and the cubic volume of logs for various diameters and lengths. The ratio can be considered a measure of the amount of total wood content which is included in the board-foot scale (if all the wood was included, the ratio would be a constant 12). The plot is of interest to the problem of log weight estimation because it clearly shows the wide variation of the board-foot to cubic-foot ratio with log size.



The plot is based on the scribner formula rule,  $\frac{2}{}$ 

$$V_B = (0.79 \ d_1^{'2} - 2d_1^{'} - 4) \ \frac{L}{16},$$

which approximates the Scribner log rule to provide a continuous curve. Similar relationships can be obtained for other log rules and scaling practices. Cubic volumes were calculated by the Rapraeger rule, 3/

$$V_C = \frac{\pi}{576} (d_1 + \frac{L}{16})^2 L$$

which assumes a taper of 1 inch in 8 feet. In calculating these cubic volumes, a trim allowance of 8 inches has been added to the scaling lengths,

$$L = L' + 8/12,$$

and one-half inch has been added to the scaling diameters,

$$d_1 = d_1' + 1/2.$$

This is to correspond with the west-side scaling practice of dropping all fractions of an inch from the scaling diameters and adding a trim allowance to the scaling lengths.

### APPENDIX II

### TABLES, GRAPHS, AND WORKSHEETS

The following tables, graphs, and worksheets are provided for determining the density index and for estimating log weights. Tables 1 and 2 are cubic volume tables for determining the density index. For convenience, a worksheet (fig. 26) is provided for computing a density index from a truckload of logs. Figure 27 is a worksheet for a moving average of the density index. Log weight estimates can be made from the graphs (figs. 5-25) or tables (tables 3-44) after the density index has been determined.

 $<sup>\</sup>frac{2}{}$  Donald Bruce and Francis Schumacher. Forest mensuration. New York, McGraw-Hill Book Co., Inc., 483 p., 1960.

 $<sup>\</sup>frac{3}{J}$  J. R. Dilworth. Log scaling and timber cruising. Corvallis, Oregon State University Book Stores, Inc., 448 p., 1965.

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Table 2.--Cubic log volumes for scaling lengths of 34 to 60 feet

ND	ARGE E								SCALIN	G LFNGT	H (FEET	,					
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The control of the	11	14.8	15.0	15.2	15.6	15.0		9	9	9	9		1	7.			0
The control of the	12	18.3	18.6	18.9	19.6	19.6		0	0	1.0	1.	**	10	0	OJ.	0	0
1	P)	22.2	55.6	23.6	23.07	2403		e CU	0.1	-23	9	O LLJ			-		90
	14	. 57	1		3 - 0 - 5	7400	0	0	•	-1	0	0	NO I	20	100	3	4 4
10   10   10   10   10   10   10   10	15	1 10	7. 0	1000	4 0	100		٠ (		0 1	a a	a (U.S.)	o u	C: P		• ••1 0	40.7
10   10   10   10   10   10   10   10	17	41.6	1000	6703	2000	4000	0 4	9 0	0		3 -	0 0	9 0	. 4	0 9	9 0	T C
Fig. 6   F	4 F	1.00	7	) T		F 2 2		9 G	e o	B 4	10	9 0		117			67.
1.   1.   1.   1.   1.   1.   1.   1.	19	53.6	54.8	25.9	58.1	69.3		10	-3	0	7	0	10	0	7	100	76.
74.4. 77.1 77.8 81.4 84.2 87.8 87.8 89.8 90.2 93.8 1 88.6 10.2 1	20	69.2	61.5	6208	65.4	67 ° P	- 6	0	0	9	9	0	0	0	9	10	87.
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Table 3.--Log weights for scaling lengths of 4 to 32 feet: density index = 30 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIES\*) FOR CENSITY INDEX=30

3986								SCALING	LENGTH	(FEET)						
CINCHES)	5	9	80	10	14.2	14	146	17	18	32	22	24	26	7.08	63	25
æ	(7)	•03	÷	C3	es es	• 0E	feel		. 07	co	0	657	# 8	(3)	හ ධා ම	0.08
۲ ٥	(2) (2) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4	4 T 4	900	F3.	60 E 133 T	ರಾ ೧ ೧೫ ಕ	ED P 171 7 9	ा •	ت د ۱۳۱۳	पूर्ण () पूर्ण प्	12	* 12	*12	100 cm	₹ण १ इसे १ #	100 C
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10	. 000	gn - co	12	f n-1	.17	1 +4	1 (1)	10	.24	i (U)	.27	. 29	J (V)	J M	* * 7 k3 7 k3	) औ ( P) e e
er c	GU (	TH .	+ 10 (		• 24	(C) 1	W I	C/3	• 29	10 1	M).	Mil.	NO.	3	4	P/ 42 ·
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7) dy ■ (+)	7 PO		15 h	UPO	о М • •	· 소호	0 48	1 3	* * \$ FU	2 15	7 1	D 43	r. 6	20	0 P	4 6 4
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16	0.17	24	25.	(1)	3	TU.	W	161	99.	1	1	(X)	00	0	2	
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F 10 1	2 15	-10	2	5° 41	:0 I	100 I	0	00	9.38	10.37	1.03	2 e 3	(A)	4.2	50	9
10 CM	2.23		J U	U Di	5	0	(C) (C)	CIL	0	E	100	2.5	0	7 - 2	5.7	S) r
וז נ.	C	10	w F	, 19	ည်း ( ေ	) ) (	)1 [€ ø	. a	40	el () el ()	T • U	) r	1 P	0 d		· r
	3	0				0	9		7   *			•	0 1	y! o	m 1	• ;

Table 4.--Log weights for scaling lengths of 34 to 60 feet: density index  $\approx$  30 pounds per cubic foot [Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

ARGE E						A second		SCALTA	G LENGTH	2 ( 7 ( 7 )	1)					Annual An
(INCHES)	JT V	\$ N	2 2	5.	3 19	27.	7	3	74.5	a .			7,	2)	Q :	4
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, 					7	3	0 4 .	6 4 9	. 7.7.	20.	E.	- H	12	, r	1 44 .	. ·
12				3 , •	- 6	* F.7	46	. 62	600	V.	wi!	-	15.	99.	2	*
1.5		۰	(°	0 / 1	. 7 .	.1	o 7 F	9 7 6	3 - 0	r-	, n •	a	a	OF .	O.	€ (1)
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ار م ای م	0, 0)	20 4 20 4 7) 4	- C - V		70 07	4 100	L 10	4 4 6 C C C C C C C C C C C C C C C C C	00	graf (the	1010	pril 3	N 3	N .:	N -4	**
17	1000	400	7.07	4 7	1001	1000	E IV	07 07	0 4	2 4	1004	21	3110	2	3 1-	4
18	1042	5	1043	U)	1.50	1.65	42.2	1.70		1 1	1.833	000	0	_ O	O.	2.0
19	1.01	0.5	1.58	0	1.84	1.87	01	1.00		2	2.69	-	-pml	N.	2	2.3
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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIPS\*) FOR DENSITY INDEX=32

NCHES)																
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Table 6.--Log weights for scaling lengths of 34 to 60 feet: density index = 32 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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	54	0	40	E PO	Jt l	1 2	~ C		5 .	3,1		· (M)	90	(T)	0	0 3	α. • •		α c	• •	M	0 1	•	2.0	~ ×	100	10 C	2 6	700	11.000	6.6	400	0.0	6.0	1 C	2.6	W .	4 1	. F.	700	رام دار
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	G (2)	· .	* C7	65.	2 0	 1 .c	75			0 1	9 9		0 1			0 1	9	0		0 0		0 0			0 1			.0	00,0	11.16	-	N C		~ .		, ,		-in	7	5	-
	5	- 1	- 0	57.	47 -	L	11	OF:	71 .	1 500	1 1	10 6	7 10.	. +	1116	- C.	. 10	27	-11	11	m 1.	100	· Ou	A .	PH 40	(6)	A 00	כייה ב	0 0	10.98	104	1.9 2.5	· .)	10	100	17 12		707	2	7 0 7	300
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DIAMETER	INCHES	9	~ 00	on .	1 1 4	17	1 2 1	14	T 4	15	18	19	21	22	23	25	26	27	29	30	41 0	200	30	E CO	0 P	38	Q. 43	41	42	25	45	46	4 3	64	51	55	رن در ا	3 22	56	5.7 a a	600

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

INDEX=34
DENSITY
FOR
(KIPS*)
WFIGHT
007

	(INCHES)	3	9	er.	10	12	李节	16	17	87	20	22	54	26	28	23	כיו
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1	- 00	3	.07	3 -3	3 41		4	4 4	1 🗂	9 7 6		) (C)	4 44	10		12.4	0 0
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1.52   2.26   3.01   3.73   4.66   5.86   6.21   6.85   7.24   7.92   8.58   8.98   9.88   9.01   10.54     1.52   2.26   3.01   3.73   4.66   5.86   6.21   6.85   7.24   7.92   8.28   8.98   8.98   9.88   11.014     1.52   2.26   3.01   3.73   4.66   5.87   6.74   6.74   6.74   7.92   8.68   9.89   10.84   10.84     1.52   2.26   3.01   3.73   4.66   5.87   6.74   6.74   6.74   7.05   8.68   9.80   10.84   10.84     1.52   2.26   3.01   3.75   4.02   7.07   6.74   6.74   7.05   8.68   9.80   11.02   11.04     1.52   2.02   3.02   7.02   7.02   7.05   8.68   9.84   10.67   11.02   11.05   12.05     1.53   3.02   3.02   7.02   7.02   7.05   8.02   9.04   10.02   11.05   11.05   11.05     1.53   3.02   3.02   7.02   7.02   7.02   8.02   9.04   10.02   11.05   11.02   11.05   11.05   11.05     1.53   3.02   3.02   7.02   7.02   8.02   7.02   8.02   7.02   7.02   10.02   11.05   11.05   11.05   11.05   11.05     1.54   3.02   7.02   7.02   7.02   7.02   7.02   7.02   10.02   11.05   11.05   11.05   11.05   11.05   11.05     1.55   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02     1.55   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02     1.55   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02   3.02     1.55   3.02   3	24		12	1.	47	1	100	1	1 1 6	6	5.50	0	CL a	7	0.37	· w	
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7 2.74 5.54 1.87 16.18 8.34 9.83 10.40 11.667 11.76 12.87 13.04 15.07 16.16 17.23 8 2.92 3.77 1 5.27 7.44 8.54 9.83 10.42 11.51 12.18 13.34 14.40 15.62 16.75 17.86 9 3.61 3.64 6.18 5.45 7.77 8.95 10.18 17.70 11.47 12.62 13.82 15.61 16.18 17.35 18.51	56	[v	4ml 5 , 6	0,00	9	C	CI	₩ ₩	7.0	3.5	[*. • €	2.4	304	4.5	77 73	6.6 6	<b>~</b>
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Table 8.--Log weights for scaling lengths of 34 to 60 feet: density index = 34 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

	RGE		and the second s		Section of the latest				SCALING	G LFNGTH	H (FEET)	( )			TANK BERNET WITH B		
	INCHES)					14											
1	G	, and	53.	2001	. 09	0)	0 0	e 7.9	@ @	C21	C	20.	100	- 67	90	9 ] •	
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No.	8	N	•22	Aili	. 22	03	828	(V)	e 22	N)	OH:	•22	01	.21	• 21	0	•
10   10   10   10   10   10   10   10	σ,	LAN L	3 6 N3 -	NO.	T .	M).	C3 1	m .	N .	Y) .	M) 4	N .	M .	25.	T .	M) 4	٠
1	2 Y	2) U	7 L	0-110	m 14 15	3 15	3 Li	3   6	5 th 0	3 4	Jr L	\$ a	3 14	3 0	3 U	3 4	
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10   10   10   10   10   10   10   10	13	1	077	1/2	000		9 00		700	, cc	- 0	91	0	. 93	460	- 0	
1.	14	0	.92	(70)	96.		1.02		1. 34		1 (2)	1.11	्र •	71	1015	41	1.18
No. 10   N	15		1.00 m	hand	1.14		1.24	l	1024	03	N	4 3 2	M)	80	1.38	47 0	10
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	17	-9-	1.44	. 40	173 173 197		1,664		1.00	P 1	P=-	₩ 00 ° ₩ 11 ° °	00	۰ CD	1,94	0, 1	**************************************
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2,000   1,00	25	NO.	3043	100	2.67		36 €	-11.00	4010	D.L	IK.	4.50	(C)	1~	4.87	0	ខ្មា
	26	.col	30.74	m	30.04		4.32	ART C	4.48	101	P-1	4.92	0	2	5,33	3	in.
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1	200	No le	100	0 0	1 000		010		1000	+10	- ان	10 m	3 -		1000	3	2 1
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5   5   5   5   5   5   5   5   7   5   7   5   7   5   5	223	v 4.	r o c a		5. 72		7. 21		7.50	a.	4-1	8 + 41	T:	6.	9.18	9 ° t	U
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20.06 20.61 21.015 22.22 23.28 24.33 24.85 25.37 25.40 27.42 28.43 29.43 34.42 31.40 32.37 3	57	1	1	10	10 1		3 2 3 5		3	700	1.7	27.41	0			101	0
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	53	100	21.35	0	30		25.22		0	70.2	3 - B	8706	7 5	5	7, 7	L	7

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIPS\*) FOR DENSITY INDEX=36

	100	-							SCALIA	G. L. MGTH	1 (5117		man and the second second and the	\$	١	ı	*
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1.14   1.77   2.81   2.81   2.81   2.82   4.84   4.84   5.84   5.84   5.84   5.84   7.84   7.85   7.81   7.85	37	1	-	1 44		-	ú.	•	2	0	. 1	3	2	3	0	40	
1.6.7 1.89 2.59 3.41 3.70 4.29 4.87 5.16 5.45 6.01 6.02 7.76 7.66 8.70 6.02 6.01 1.00 1.00 1.00 1.00 1.00 1.00 1.00	S. F.	1 . 14	NIP	N. 0 . 1	~ 15		2	0	ر د	0 1	112	0 0	7 1	2 0	-	E	0
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2 1.44 2.08 2.76 3.43 4.05 4.74 5.39 5.70 5.02 5.65 7.27 7.88 8.48 9.08 9.08 9.66 10. 3 1.46 2.18 2.89 3.50 4.20 4.98 5.65 5.99 5.32 6.98 7.63 8.27 8.91 9.08 9.08 9.08 10.15 10. 4 1.10 2.13 2.14 2.14 2.14 2.14 2.14 2.14 11	41		1	7 7 . 7	q		JL		4 3	-1	10	0	1 3		1 0		
3 1.46 2.18 2.89 3.56 4.20 4.98 5.65 5.99 6.32 6.98 7.63 8.27 8.91 9.53 10.15 10.5 11.5 11.5 11.5 11.5 11.5 11.	42	1.40	13	2.76	-9-	-	- 7	60	Pol	0	9	C/3	α) •	3	0	9	0
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1.75 2.651 3.47 4.31 5.44 5.97 5.78 7.48 7.59 8.38 9.17 9.651 11.07 11.97 11.52 12.28 12.38 11.07 1.07 11.07	44	·,,,,	4 10		e 1-	- 1	1	0 /1	V L	210	01	01		. L	0 3	0 -	
1.75 2.651 3.47 4.31 5.14 5.97 5.78 7.49 7.59 8.38 9.17 9.95 11.71 11.47 12.22 12.20 11.71 11.71 11.47 12.22 12.20 11.71 11.71 11.72 11.39 12.77 12.60 11.71 11.72 11.39 12.77 12.60 11.72 11.30 11.72 11.30 11.72 11.30 11.72 11.30 11.72 11.30	200	m 1:	"	2000	-	5	9 0		0				، ه			4 U	
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9 2.77 4.1? 5.49 6.83 8.16 9.47 10.78 11.43 12.08 13.36 14.63 15.89 17.14 18.37 19.66 20.00 0 2.86 4.62 15.14 16.45 17.74 19.02 20.29 21.	58	2.67	0	5.30	10	60		-5	4	4.6	C	4.1	15°	 	7 . 7	00	9
6 2.86 4.27 5.67 7.46 8.44 9.80 11.16 11.83 12.50 13.82 15.14 16.45 17.74 19.02 20.29 21.	59	2.77	und .	5043	00	-		10	1.4	2.0	M)	9.4	57 P	7 . 1	100 a	9°6	2
	90	2.86	CS	200	~3	3		1.	108	50 50	00	5.1	9.4	7.7	0	6.2	÷1

Table 10.--Log weights for scaling lengths of 34 to 60 feet: density index = 36 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

0	RGE E								SCALING	G LENGTH	(FEFT)	,					
	AMETES)				00 P2											57.8	9
1.   1.   1.   1.   1.   1.   1.   1.	9	0.13	0.13	E	977	.16	• 08	о Э О,	• 00	~	0.08	80.	C:	10.	. 37	9,6	•
	7	•16	9 7 0	.16	-	-1	$\frac{1}{2}$		150 171 18	44	lás i eri e	<b>+</b> 1	44	.14	44	<b>T</b>	٠
10   10   10   10   10   10   10   10	0	• 23	• 23	923	LVIII.	cili	r Ivo		\$ 24	1100	0.23	N) °	CA L	cul t	N !	0 1	
1	D ::		0.50	2 10		n s	Y) 3		2 4 2 4 4	NO -2	# 4 9 4	93	€	٧, خ	AD 9	Y) 😋	
1.00   1.00	11	0 0 0	10.		2 177 ,	r luc	1 5		0 C	10	1 1 1 1 1 1	10	0	r vo	F O	. 62	
1.00   1.00	12	990	.67	. 58	100	Do	1		• 75	1-	.77	1	1	1-	700	90	•
1.   1.   1.   1.   1.   1.   1.   1.	17	080	. 81	.co.		100	0,		20.	0	0.00	O.	0	0	-	٥	1.
1.	14	.95	.97	66.	C	733	0		1.10	딕	1,15	41	7	D.J.	All	2	1,0
1.   1.   1.   1.   1.   1.   1.   1.	15		101	1015	. 0	W	2		1. 1	Pz :	1.37	2	7	3	4-	7 .	1.50
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	16		1077	1.05,		+ .	31		T • H	2	1.61	ه اص	9	2/0	B. 1.	7	**
19   19   19   19   19   19   19   19	1.6		1000	1000	-	0.0	- 0		1 . / B	ည္း	100	an c	ית פ	T - C	-9. Pr	۰	
2   2   2   2   2   2   2   2   2   2	10		Te / 4	7.7		2 4	20		2, 74	3 1	2 12	ی ای	0 5	ul c	0 . 0	9 1	2 6
2.68	20		2.21	2.26	2 172	4 -31	. U		2.64	2 40	2.76	V 60	. 0	0.00	S (27)	. co	ניין נ
2.55 2.35 3.40 3.29 2.20 2.314 3.20 3.50 3.45 3.45 3.50 3.45 3.45 3.50 3.45 3.45 3.75 3.40 3.40 3.40 3.40 3.40 3.40 3.40 3.40	21		1 4 0 7	2000		3	T		2002	-	7.10	1-	2.	IN.	4	7	P)
2.25   2.25   3.40   7.55   3.75   3.75   3.75   3.75   4.00   4.25   4.26   4.27   4.65   3.75   3.75   3.75   3.75   3.75   4.26   4.27   4.27   4.26   4.27   4.27   4.26   4.27   4.26   4.27   4.26   4.27   4.26   4.27	22		2.74	2.83	0		77		3.25	53	3.45	123	9	Pour	~	20	(A)
3   2   3   3   3   4   4   5   5   4   5   5   5   5   5	23		3.03	3.09		No.	47.0		3.60	1	3.82	S	0.	9-1	0.1	(N	4
1.   1.   1.   1.   1.   1.   1.   1.	54		3 . 32	3.40	77.7	LC.	007		3,96	9	4.22	M	4.	LO:	-01	7	110
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4.55 4.66 4.77 4.98 5.10 5.10 5.10 5.10 5.10 5.10 5.10 5.10	97		3.40	4.00	0	20	D 0		3 0	2 1	2000	110	۳) a	BIL	ol –	-	2
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5   5   5   4   5   5   6   5   6   5   6   6   6   6	0 0		0 00	0 0		4 4	T		5. (5	· ~	0000	20 أ	) «C	NE		0 7	7
1	30		10 4	50.00	- 1	0	0		6.52	1	6.98	N,	-7	LC.	c m	ت •	00
0.00   6.22   6.37   6.60   6.95   7.24   7.38   7.52   7.79   8.00   8.00   8.32   8.57   8.83   9.00	3.1		1) •	4001		.3	1		7.11	0	7.51	1-	0.	0	-0-	3	8
8 6.94	32		6,22	6.37	9	6	57		7.52	1	8.06	PO	5	00	-00	6.1	9
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7.88	34		99 :-	1 23	4	0	1 1/2		00 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		17.0	0 +	D :	4 1	100	۱۰ و ۱۰ و	3 T
	190		. B . E	8.20	• 1	- 0	. 1		0,70	0 0		1 1	• •	- 4	. C	9 4	1 (
1.	37		H 17 . 1			16	) [			7 0 7	0	t.	9	0	117	0	( P)
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11. 36 11. 39 11. 39 11. 30 11. 37 11. 66 12. 67 13. 13. 13. 69 14. 40 14. 46 14. 46 14. 48 11. 39 11. 39 11. 30 1	30		- t	~	0	5	1		1.	1.9	5	2.8	3 + 2	3.6	0 0 7	404	7
11.65 11.69 11.37 11.67 11.67 12.40 13.07 14.65 14.80 15.70 14.69 15.10 16.09 11.37 11.69 12.40 13.07 14.65 14.80 15.35 15.40 16.60 11.66 11.66 11.66 11.69 12.40 13.07 14.65 14.80 15.35 15.80 16.60 17.65 12.64 15.07 14.65 14.80 15.35 15.80 16.60 17.65 17.60	J .		end -		0	C .	0		0	0 1 0 1	w) [	9 ,	3 .	4,0	1, 20 01 10 11		1
11.56 11.66 11.95 12.54 13.12 13.09 13.97 14.29 14.80 15.35 15.88 16.41 16.93 17.4 11.56 11.56 11.95 12.54 13.12 13.09 13.97 14.27 14.29 14.29 14.29 14.29 14.20 1	20		11.00			- 7	. =		9 1		0 4		• 11 • 12 0 12	0 10 0 10	~ <u>15</u>		9 6
	123		11.66	9 -	0 0		2 0		7 3	1 2	L	500	2 2	0	7 - 4	7.9	
15.5 17.5 17.15 17.41 14.45 16.19 15.30 15.71 16.71 16.72 17.50 17	17		17 - 7 -	4 0 1		11			· ·	. D	1 4	0.0	7 . 5	7 . 8	. W	. ac	0.
	4		1:001	1.0	14	1 3	7		10	5 . 3	0	7 . 5	3.	6.5	0.3	3.6	3
	746		7 9 0		4 0	7	a'		9	7.1	-	10 i	D .	0 P	6.2	8 · D	e Tri
14.51 14.67 17.87 17.82 17.29 17.59 17.59 19.44 17.82 19.47 20.12 20.81 21.49 22.19  19.57 16.71 17.41 17.67 17.52 18.45 17.67 17.64 21.67 26.70 21.02 20.81 21.46 22.14  10.57 16.71 17.41 17.82 17.57 18.45 17.64 21.48 21.27 26.70 21.02 21.04 22.05 26.44 22.05  10.50 17.71 17.72 17.50 19.50 20.47 27.67 20.50 21.00 21.00 21.00 22.04 22.05  10.50 17.72 17.72 17.50 19.50 20.47 27.57 20.50 27	147		1600	0	0	3.	-7		-	7.00	\$	3.6	0.0	٠	1.1	7 . T	. 7
14.5.7. 15.7.4. 15.7.4. 16.5.2. 17.2.6. 19.44. 17.9.2. 19.57. 21.0.2. 21.75. 22.45. 24.1  1	24		14.6		•	- 1	~		a	(C)	0	U + 1	ار د د	- t	₹	2	
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10. q. 17. 7. 11. 4. 11. 4. 21. 4. 21. 7. 21. 21. 24. 22. 27. 14. 22. 64. 22. 64. 22. 26. 35. 44. 24. 72. 26. 73. 26. 73. 26. 74. 27. 44. 34. 34. 34. 34. 34. 34. 34. 34. 34	51				300	2	•		•	1 1	1 1	2.0	7 2 7	1	10		
17.(1 1" 1 11.0 1 13.4 E 20.4, 21.7 2.22 23.11 23.00 24.8 C 26.7 26.7 27.4 4 24.0 1 25.8 7 26.7 27.2 26.7 28.5 4 28.5 1 1 1 11.0 1 21.0 1 27.0	55		17 0 7 11	0 0	9 0	. 3	- 4			0 2 0	0 6	, N		. IO	) M	7 0 1	
44 11.000 11.000 11.000 11.000 12.000 17 22.000 20.01 20.01 20.07 20.07 27.000 20.05 11.000 1	55		3 - 1		-	47 0	1.0		0	3.1	19	4 . 4	F. 7	4	707	8 . 2	.0
56 115.0. 175.0. 4 210.1 22.14 22.54 24.44 25.45 24.40 25.45 26.45 27.45 28.47 29.65 27.45 28.47 29.65 27.45	45		1 . 4 4 -	-	4	^.	i . 1		P .	7.09	7	F. B	6.7	7 . F	R . J	4.6	
11.7; 7.5; 7.5; 7.5; 11.7; 17.	5 5		1		-	- 1	_ }   		-3	G . 4	0 L1.	6.3	7 . 8	N. 1	S .		•
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9	2 L		27 • 64	0 1	O N		7 L		0 0	7 0 0	. 0	D =	) - 0 +	7 . 5	200	100 E	5 K
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	5,		7 . 17 ]			2	10 1		G		-	200	7 . 4	. 5	100	. ≈	

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LCC WEIGHT (KIPS\*) FOR CENSITY INDEX=38

ARGE E		THE PERSON NAMED OF THE PE						SCALING	HLSNET S	H (FEFT)						
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Table 12.--Log weights for scaling lengths of 34 to 60 feet: density index = 38 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 13.--Log weights for scaling lengths of 4 to 32 feet: density index = 40 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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\* 1KIP=1,30 FOUNES

Table 14.--Log weights for scaling lengths of 34 to 60 feet: density index = 40 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 15.--Log weights for scaling lengths of 4 to 32 feet: density index = 42 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet; trim allowance of 1 inch per 4 feet]

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Table 16.--Log weights for scaling lengths of 34 to 60 feet: density index = 42 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 18.--Log weights for scaling lengths of 34 to 60 feet: density index = 44 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

THOLASTON ECO CENSIA THOUSAND

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 20.--Log weights for scaling lengths of 34 to 60 feet: density index = 46 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LCG WEIGHT (KTPS\*) FOR DENSITY INDEX=48

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\* 1KIP=1000 CC FS

Table 22.--Log weights for scaling lengths of 34 to 60 feet: density index = 48 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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9	4 17	વન	**************************************	4-4	64.7 54.7	4	44	4.1	4-1	4-1		4-4	C.,	CO	5.00	*
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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 24.--Log weights for scaling lengths of 34 to 60 feet: density index = 50 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 25.--Log weights for scaling lengths of 4 to 32 feet: density index = 52 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIPS\*) FOR DENSITY INDEX=52

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Table 26.--Log weights for scaling lengths of 34 to 60 feet: density index = 52 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOC WEIGHT (KIFS\*) FOR DENSITY INDEX=54

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Table 28.--Log weights for scaling lengths of 34 to 60 feet: density index = 54 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 29.--Log weights for scaling lengths of 4 to 32 feet: density index = 56 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIPS\*) FOR DENSITY INDEX=56

The control of the	TAMET					and the second second second second second											
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11.0   1.43   1.89   2.32   2.76   2.21   3.63   3.55   3.55   4.15   4.15   4.15   5.24   5.25   5.55		J.J	0.	1.62	>	(Y7	~	4"1 0	(/)	47 0	00	7	3		4	-1"	
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1.50   2.37   3.14   3.90   4.64   5.38   6.10   6.46   6.82   7.52   8.21   8.89   9.65   10.22   10.87   10.81   1.59   2.37   3.14   3.90   4.64   5.38   6.10   6.46   6.82   7.52   8.21   8.89   9.65   10.22   10.87   11.51   1.20   1.57   1.75   1		6	0 .	2.69	N.	0C 4	ותו	<del>.</del>	4	9	0 1	80	40		: 2J	φ (	0) (
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Table 30.---Log weights for scaling lengths of 34 to 60 feet: density index = 56 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 32.--Log weights for scaling lengths of 34 to 60 feet: density index = 58 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 33.--Log weights for scaling lengths of 4 to 32 feet: density index = 60 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of  $\boldsymbol{1}$  inch per 4 feet]

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Table 34.--Log weights for scaling lengths of 34 to 60 feet: density index = 60 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 36.--Log weights for scaling lengths of 34 to 60 feet: density index = 62 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 37.--Log weights for scaling lengths of 4 to 32 feet: density index = 64 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 38.--Log weights for scaling lengths of 34 to 60 feet: density index = 64 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 40.--Log weights for scaling lengths of 34 to 60 feet: density index = 66 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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3.55   3.62   3.64   3.69   4.61   4.61   4.62	18	텧	Ni	2	ml	10	ات	9	1	<b>a</b> o i	0	9	7	23	2	W)	25
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9.68 9.02 11.55 11.55 11.07 11.57 12.57 12.57 12.58 12.80 13.21 14.64 15.72 14.57 14.57 15.52 14.64 15.72 14.64 17.59 14.67 11	29	0	N	4 0	(77)	17	9 0	3 . 6	1.0	104	100	2.5	2.6	5.9	(M	3.6	(A)
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13.47 14.54 14.55 14.54 16.12 15.44 17.54 17.55 14.55 14.55 14.55 15.55	000		- 0	1 1	10	0 4		1 ·	- f	200	0 0	1 0	ι ( 0 ľ	0 0		0 0	0 6
14.19 14.14 15.5 16.74 16.44 17.41 17.41 17.41 18.46 19.14 19.78 20.41 21.62 22.99 23.65 22.99 12.65 17.41 17.41 17.41 17.41 17.41 18.46 19.14 19.78 21.60 12.65 22.99 23.65 22.69 12.65 17.42 1	12 T	) () ) ()	0 0 0 0	0 1	0 7	0 7	0 14	2 -2	, v	400	0 0	. a	0	000	9 %	P X	9 -1
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Table 41.--Log weights for scaling lengths of 4 to 32 feet: density index = 68 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LOG WEIGHT (KIPS\*) FOR CENSITY INDEX=68

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Table 42.--Log weights for scaling lengths of 34 to 60 feet: density index = 68 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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Table 43.--Log weights for scaling lengths of 4 to 32 feet: density index = 70 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

LCG WEIGHT (KIFS\*) FOR CFNSITY INDEX=70

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Table 44.--Log weights for scaling lengths of 34 to 60 feet: density index = 70 pounds per cubic foot

[Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet]

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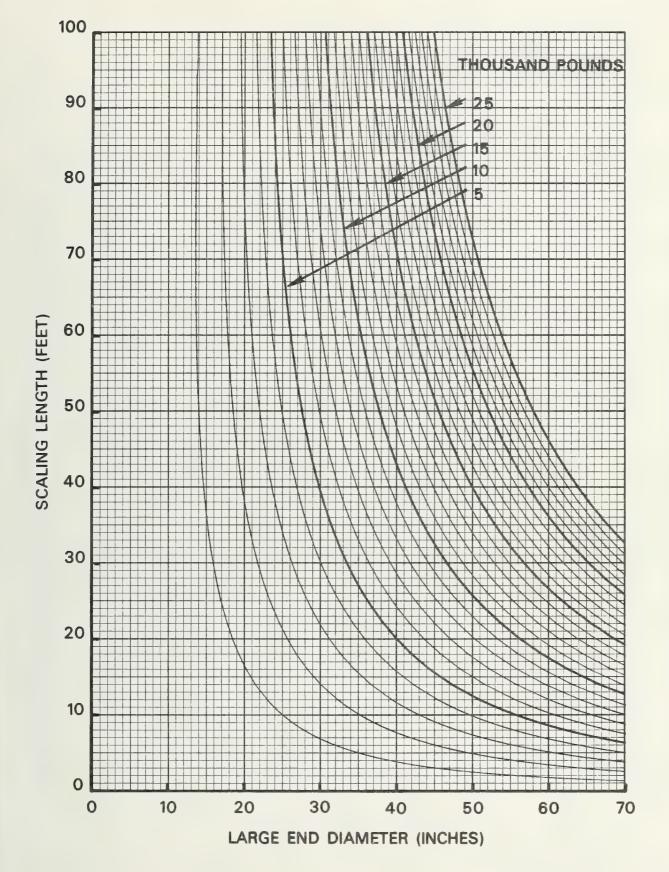


Figure 5.—Scaling length versus large end diameter for various log weights. Density index = 30 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

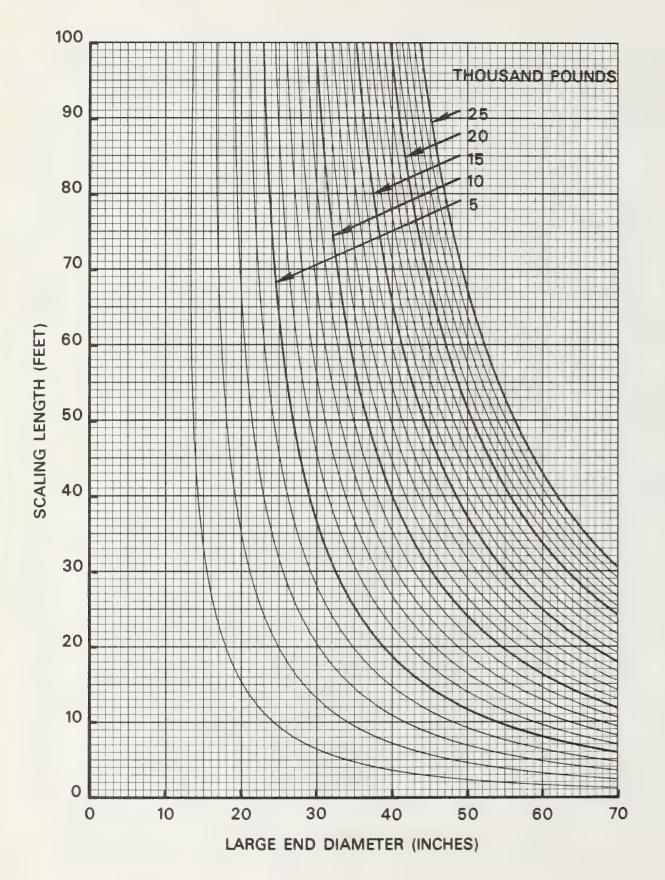


Figure 6.—Scaling length versus large end diameter for various log weights. Density index = 32 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

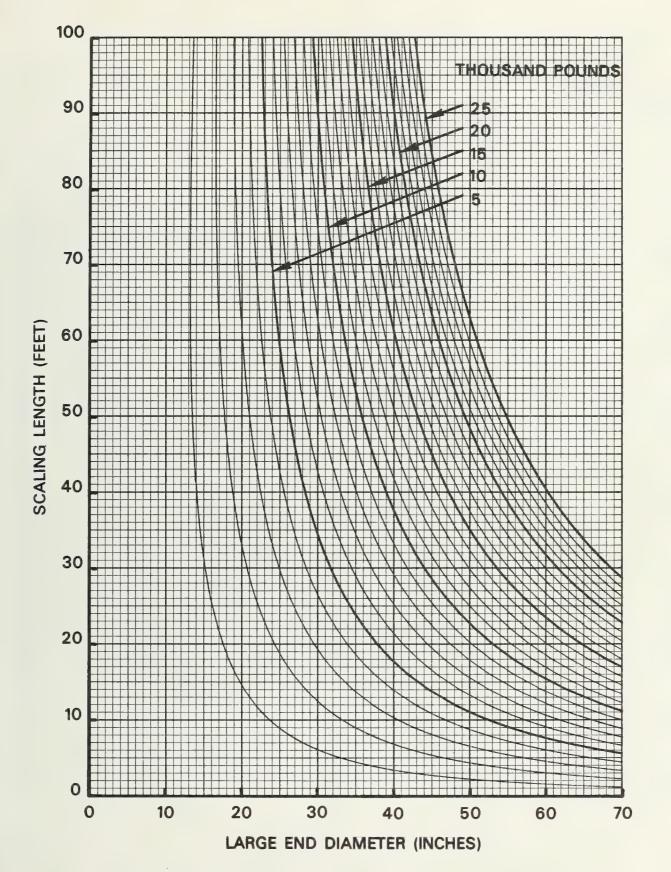


Figure 7.—Scaling length versus large end diameter for various log weights. Density index = 34 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

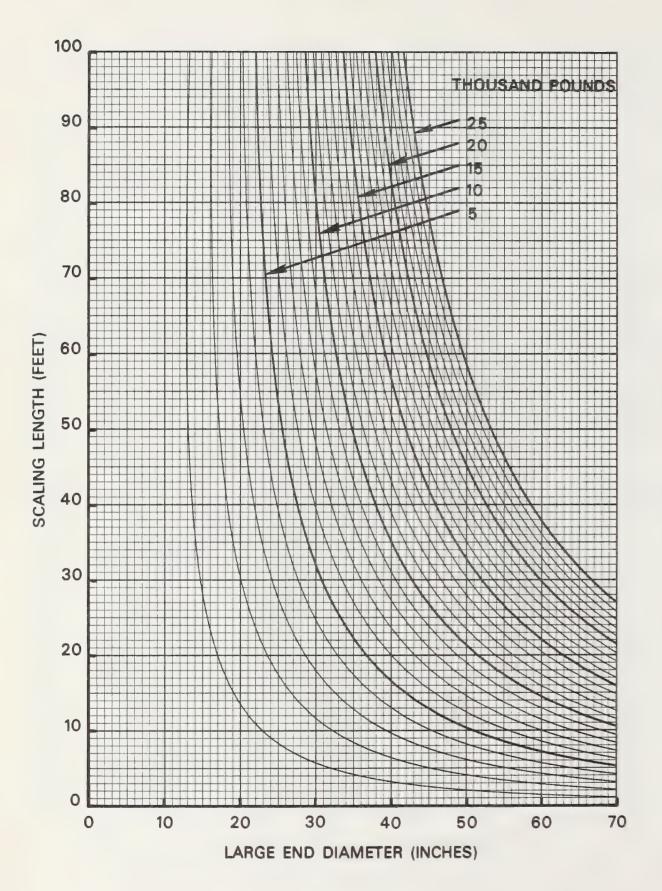


Figure 8.—Scaling length versus large end diameter for various log weights. Density index = 36 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

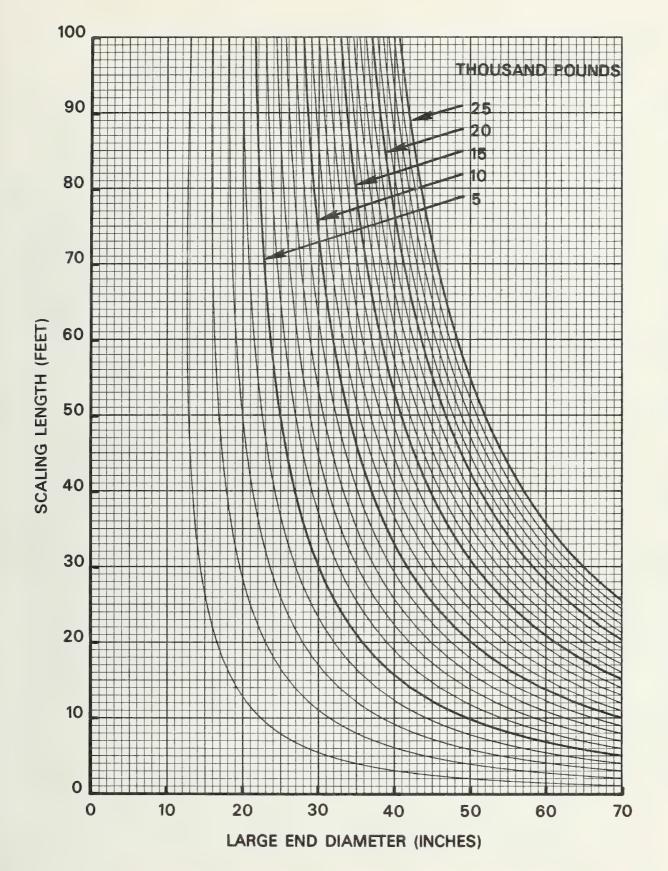


Figure 9.—Scaling length versus large end diameter for various log weights. Density index = 38 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

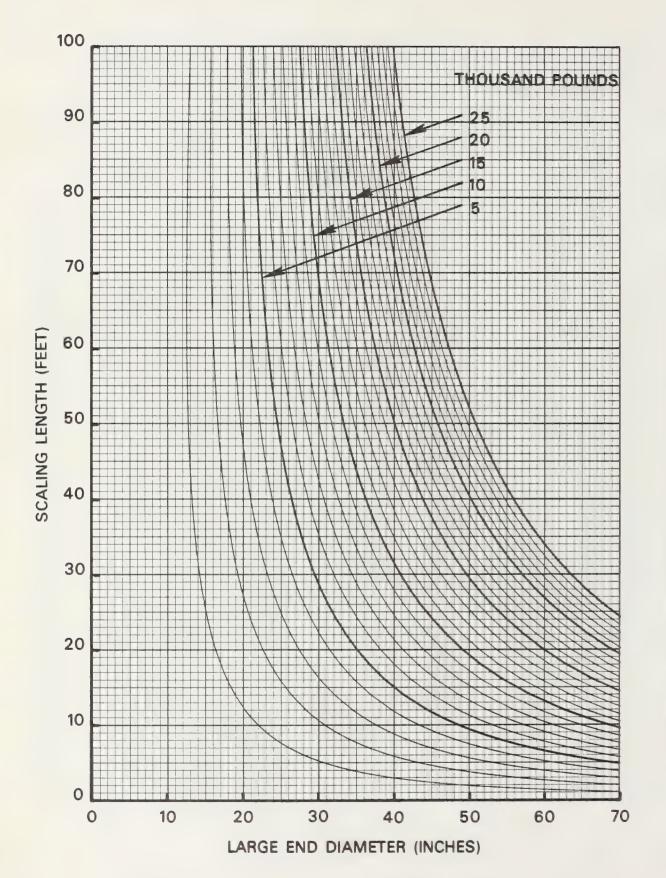


Figure 10.—Scaling length versus large end diameter for various log weights. Density index = 40 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

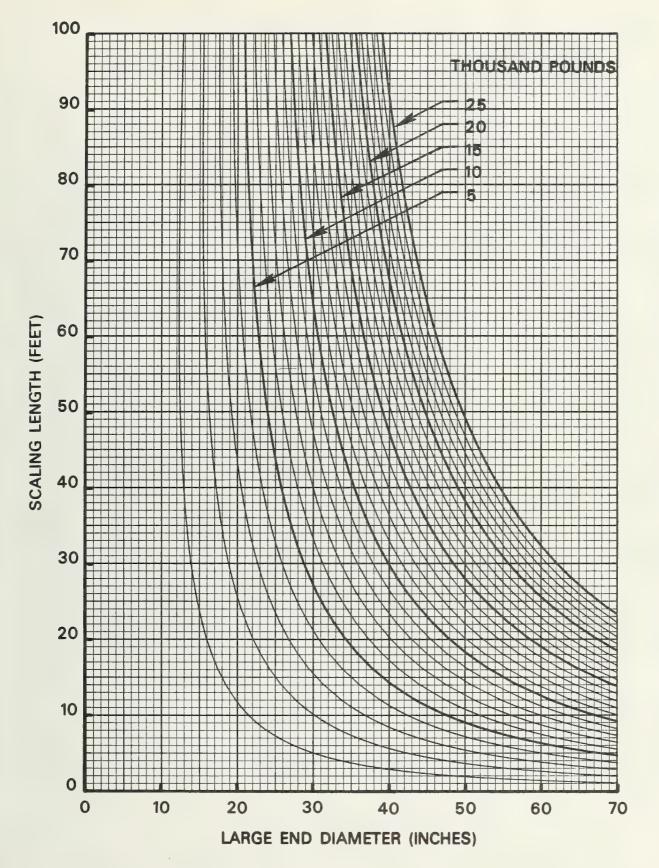


Figure 11.—Scaling length versus large end diameter for various log weights. Density index = 42 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

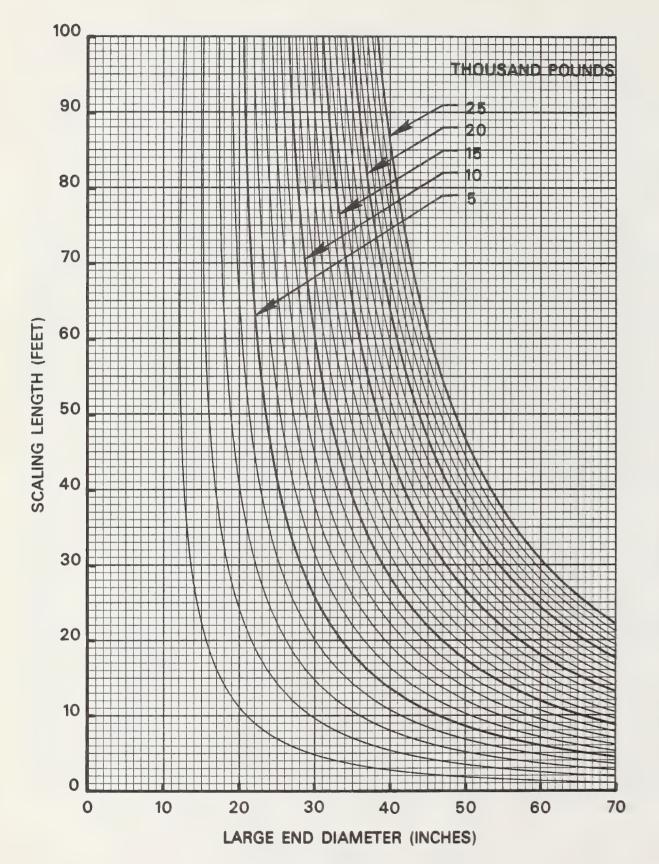


Figure 12.—Scaling length versus large end diameter for various log weights. Density index = 44 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

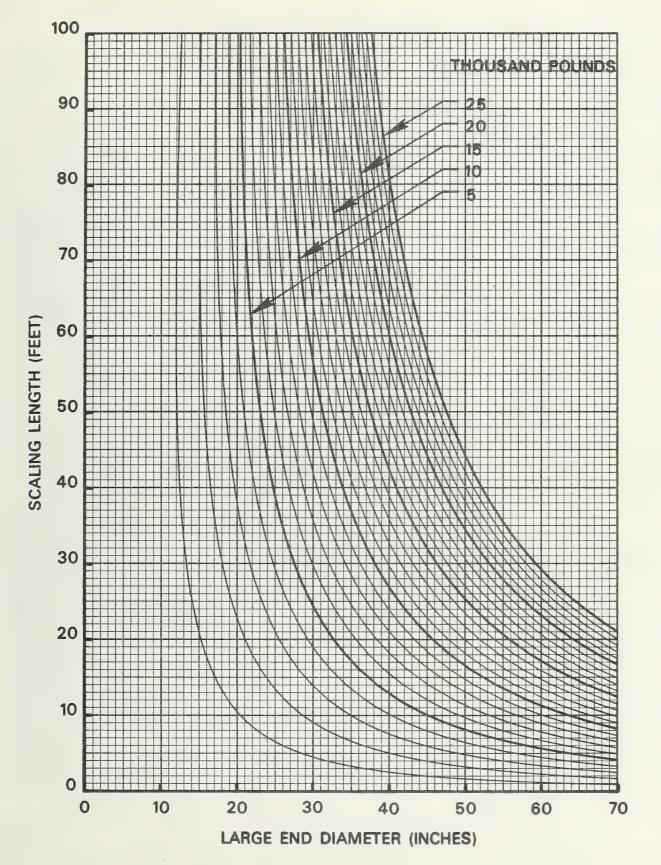


Figure 13.—Scaling length versus large end diameter for various log weights. Density index = 46 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

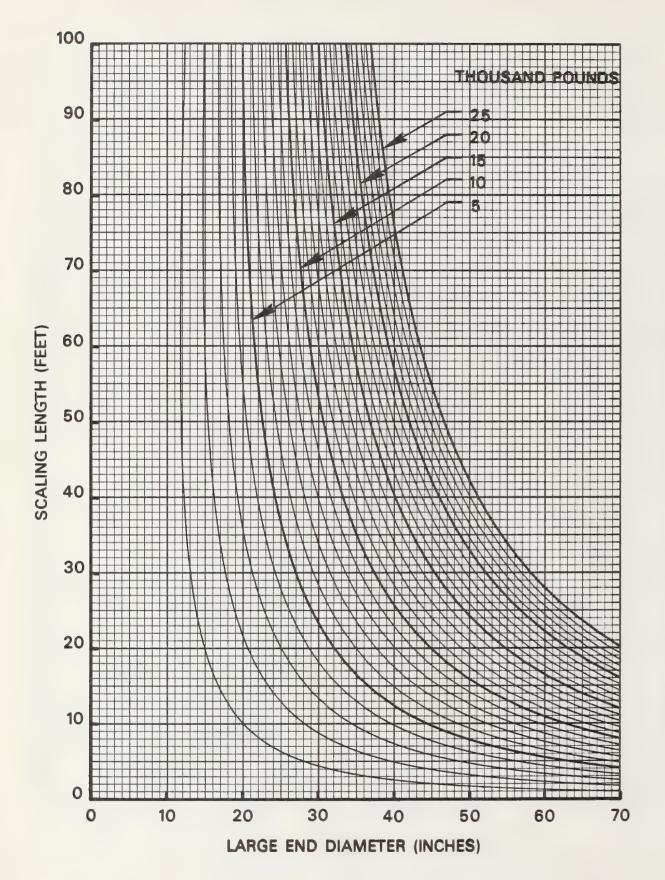


Figure 14.—Scaling length versus large end diameter for various log weights. Density index = 48 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

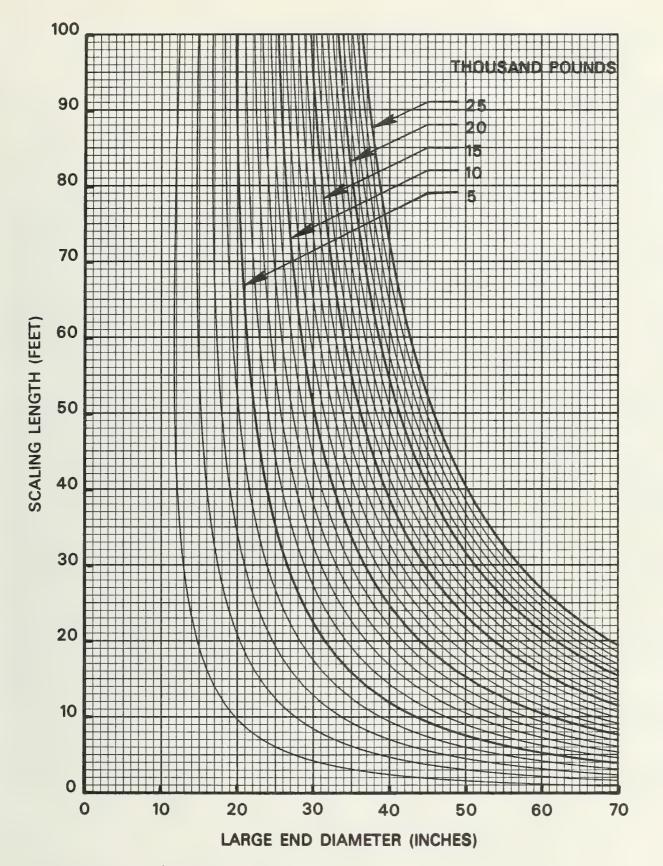


Figure 15.—Scaling length versus large end diameter for various log weights. Density index = 50 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

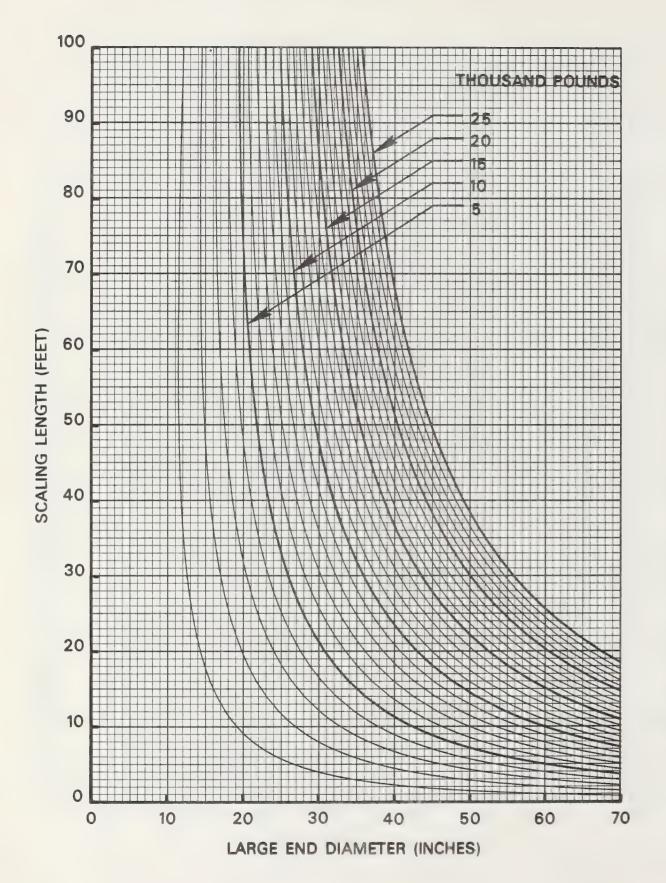


Figure 16.—Scaling length versus large end diameter for various log weights Density index = 52 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

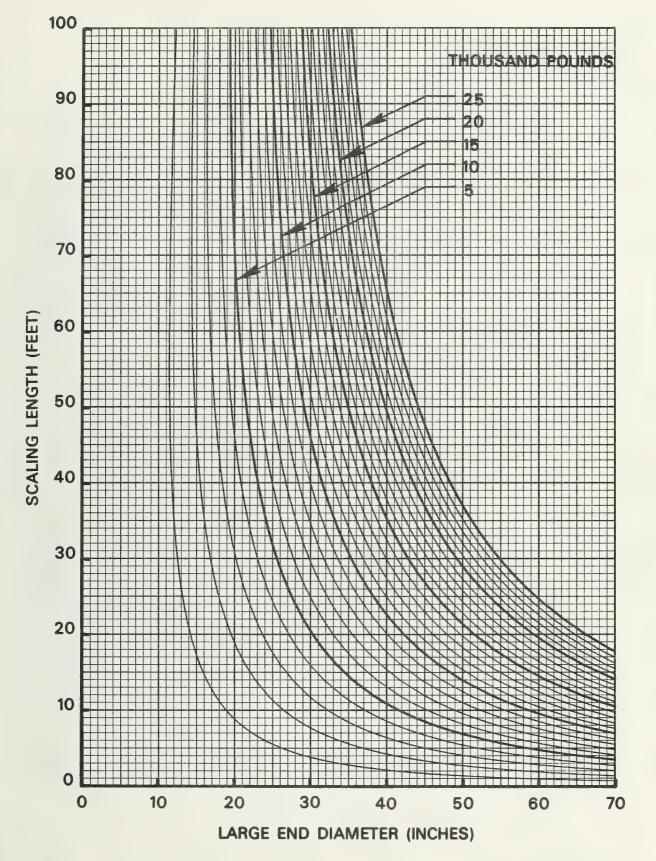


Figure 17.—Scaling length versus large end diameter for various log weights. Density index = 54 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

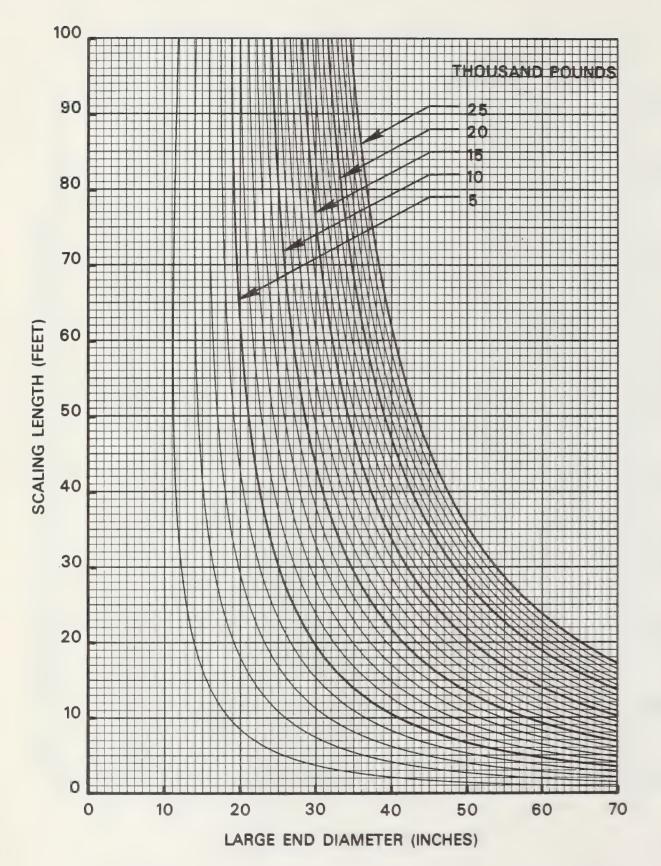


Figure 18.—Scaling length versus large end diameter for various log weights. Density index = 56 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

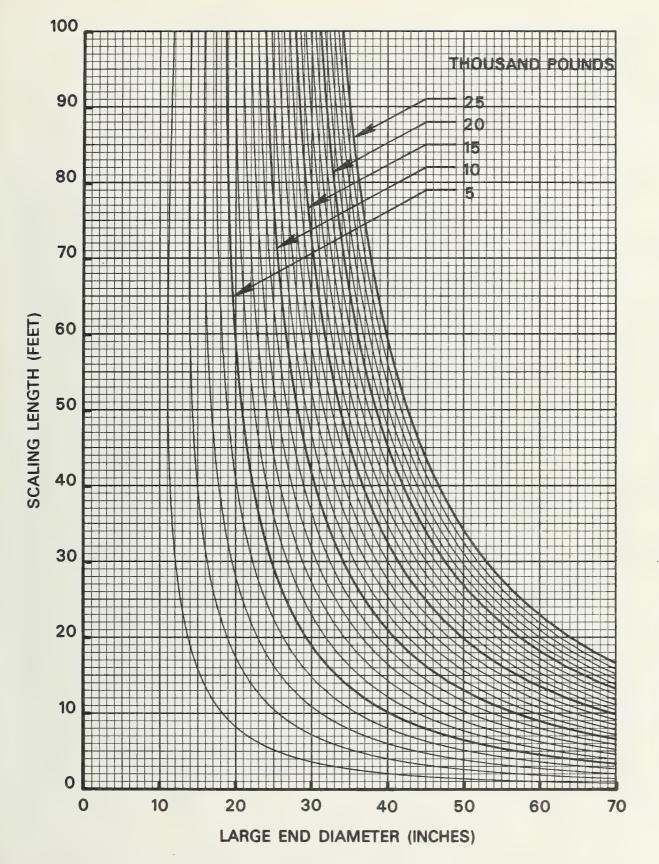


Figure 19.—Scaling length versus large end diameter for various log weights. Density index = 58 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

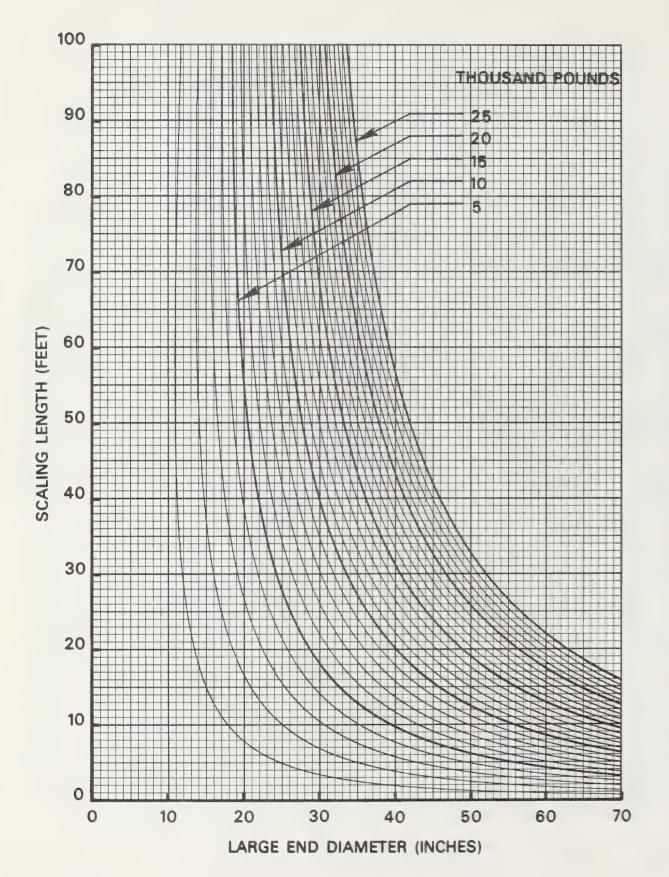


Figure 20.-Scaling length versus large end diameter for various log weights. Density index = 60 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

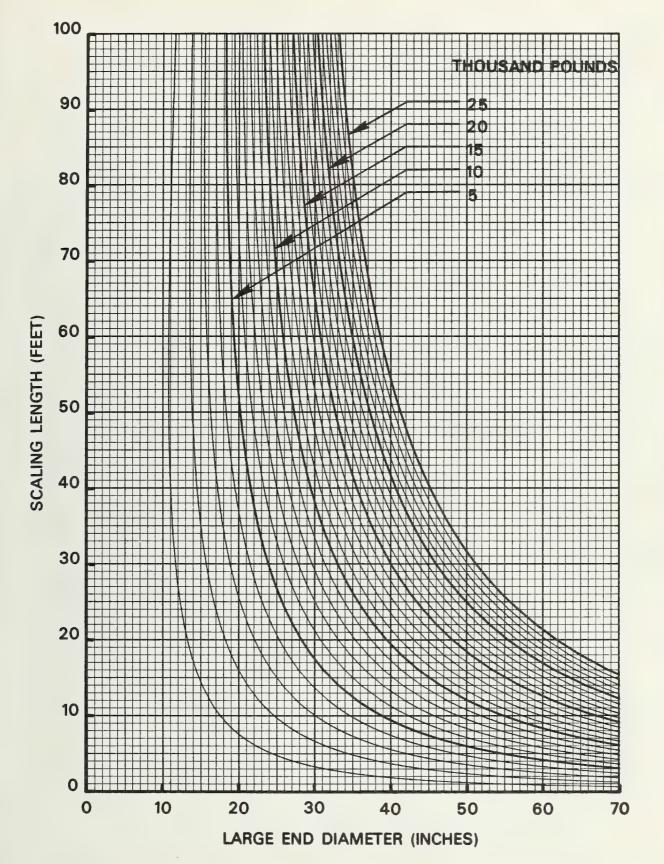


Figure 21.—Scaling length versus large end diameter for various log weights. Density index = 62 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

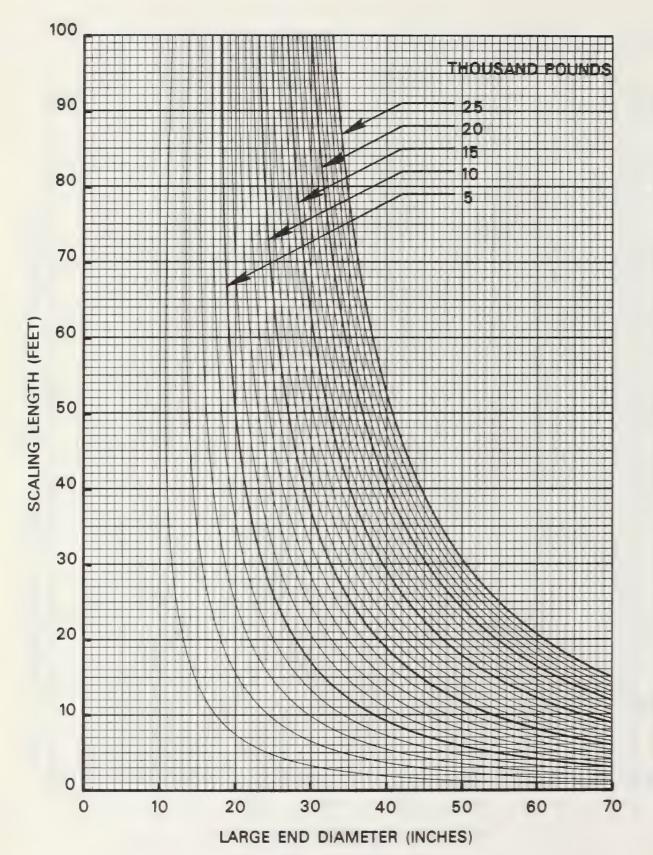


Figure 22.—Scaling length versus large end diameter for various log weights. Density index = 64 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

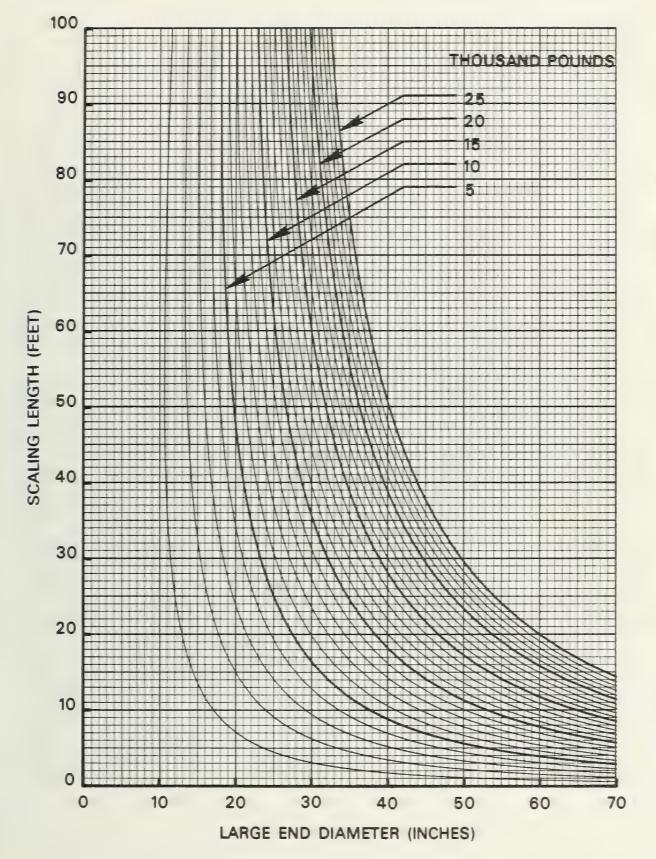


Figure 23.—Scaling length versus large end diameter for various log weights. Density index = 66 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

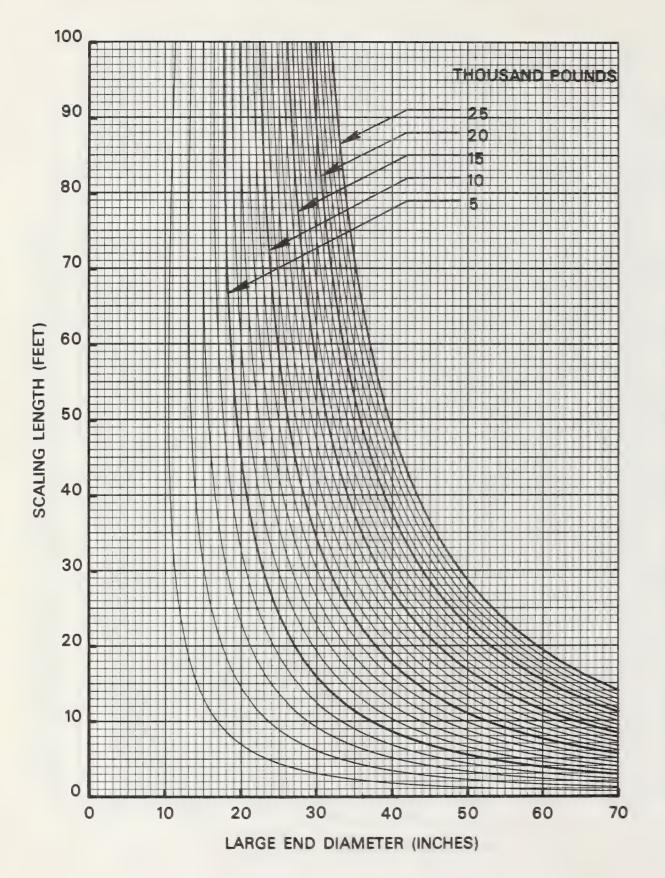


Figure 24.—Scaling length versus large end diameter for various log weights. Density index = 68 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

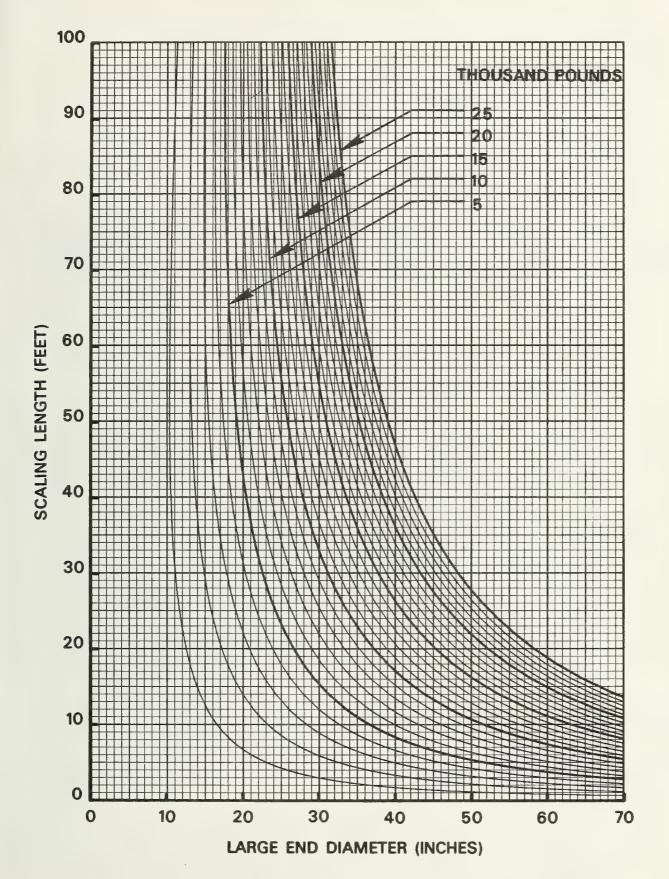


Figure 25.—Scaling length versus large end diameter for various log weights. Density index = 70 pounds per cubic foot. (Assumed taper of 1 inch per 8 feet, trim allowance of 1 inch per 4 feet.)

Figure 26.—Density index worksheet.

Sample No.	Date		Truck No	Load No	0	
Gross weight Tare weight Net log weight		_lbs.	Logging site Species			
Scaling length <u>l</u> / (feet)	Large end diameter (outside bark, inches)	Volume <u>2</u> / (cubic feet)	Scaling length1/ (feet)	Large end diameter (outside bark, inches)	Volume2/ (cubic feet)	
			TOTAL	CUBIC VOLUME		
<u>1</u> / <sub>Use</sub> .	Net log weigex = Total cu. volocal scaling praces 1 and 2.	1cu.	= ft.	11	b./cu. ft.	

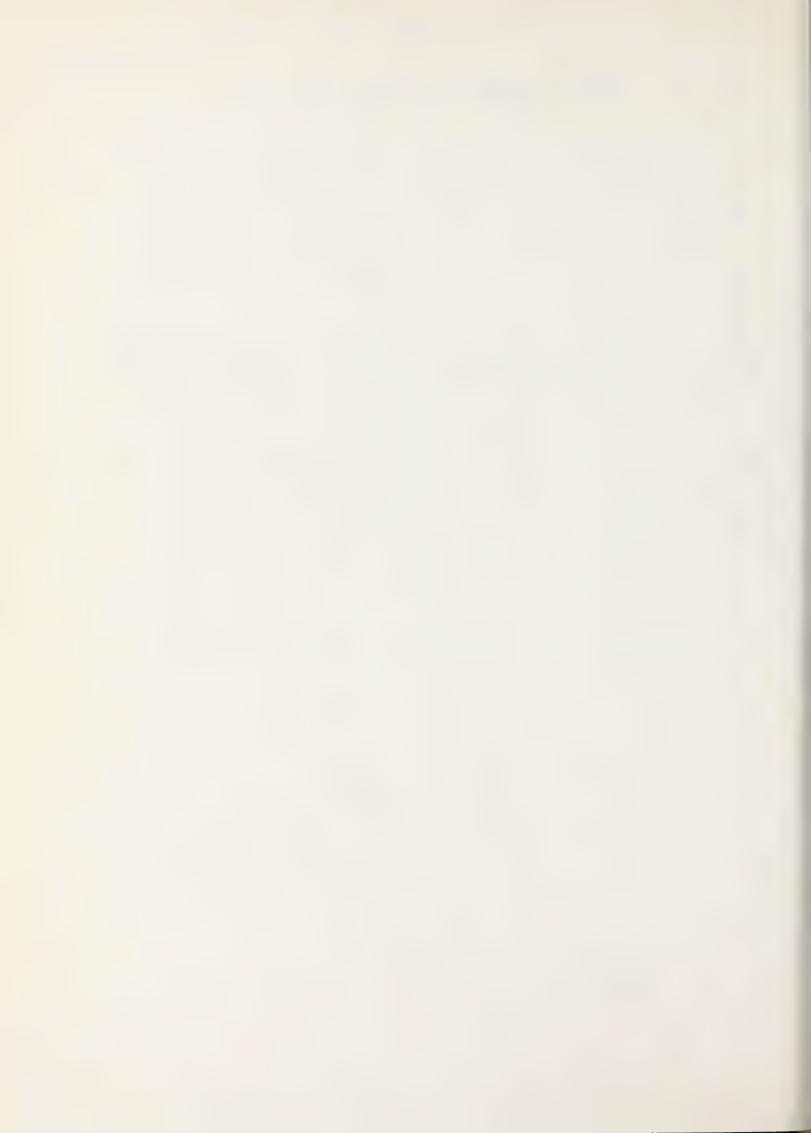
Figure 27.—Worksheet for moving average of density index.

Logging	site	Species	
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Sample number	Date of sample	Sample density index	Moving total of density index <u>l</u> /	Current moving average <u>2</u> /
			,	

 $<sup>\</sup>frac{1}{2}$  Add newest sample and delete oldest sample which was included in previous total.

 $<sup>\</sup>frac{2}{}$  Divide moving total by number of sample in moving average.



Mann, Charles N., and Hilton H. Lysons
1972. A method of estimating log weights. USDA Forest
Serv. Res. Pap. PNW-138, 75 p., illus. Pacific
Northwest Forest and Range Experiment Station,
Portland, Oregon.

Presents a practical method estimating the weight of logs before they are yarded. The method is based on obtaining an initial sample for a cubic density index and then applying the index to log dimensions for weight estimates. The use of this method should facilitate the application of aerial logging systems.

Keywords: Logs, weights, logging.

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The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

- 1. Providing safe and efficient technology for inventory, protection, and use of resources.
- 2. Development and evaluation of alternative methods and levels of resource management.
- 3. Achievement of optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research will be made available promptly. Project headquarters are at:

Fairbanks, Alaska Juneau, Alaska Bend, Oregon Corvallis, Oregon La Grande, Oregon

Portland, Oregon
Olympia, Washington
Seattle, Washington
Wenatchee, Washington



The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.